

Attachment 2

U.S. Patent and Trademark Office,
Commissioner of Patents and Trademarks,
Washington, D.C. 20231
Attention:
Examiner, Timothy Vanoy
Art Unit:1754

Appl.#:09/525,176
Filing date:03/14/00

Applicants:
Savvas Vasileiadis,
Zoe Ziaka-Vasileiadou,
15549 Dearborn street,
North Hills, CA 91343
tel.&fax: 818-893-4292
email: svas10@aol.com,
vas1cs@msn.com

May 20, 2002

Response to Office Action 01/29/2002

This is in response to the last Office Action of Jan.29, 2002 concerning the patent application # 09/525,176. The applicants have been complied with the Office Summary Action and have amended the application.

The requested reference/article to complete the Information disclosure statement was mailed to the Office in Jan.2002.

A new substitute Specification is provided double spaced and with paragraphs numbered. The substitute specification contains no new matter and amends the original specification of 3/14/2000.

A marked-up version of the original specification is also provided to show the changes made.

A new declaration is also provided with the from PTO/SB/01A in compliance with the Office Summary Request.

The drawings (Figs. 1-12), have been corrected according to the draftperson's request.

The amended specification is arranged in sections as was requested by the Office Summary Action.

The new claims start on a separate sheet of paper. The new claims 1-45 replace the old claims submitted with the original application. Original claims 1-45 are all cancelled.

Enclosed is also the \$55 fee of one month extension for this response to the last Office Action.

We are looking forward to hearing soon from your Office.

Sincerely,

Savvas Vasileiadis, *Ph.D. chemical engineering*
Zoe Ziaka-Vasileiadou, *Ph.D. chemical engineering*

Remarks Section

The new claims 1-45 submitted with this amended application replace the claims of the original specification of 3/14/2000 (old claims 1-45). Original claims 1-45 of 3/14/2000 are cancelled. The new claims have been placed in proper dependent and independent form. Claims 1,4, and 41 are independent claims and the rest of them are dependent claims. The new claims comply with the Examiner's Office Summary Action of 1/29/2002, pages 6-15, and rectify the claim objections and claim rejections under 35 USC-#112 and 35 USC-#103, as was pointed out by the Examiner. The new claims refer to the elected invented processes.

The two inventors of this application are joint inventors in all 45 new claims submitted with this substitute specification.

The substitute specification contains no new matter, is double spaced and is divided into 67 paragraphs.

An updated listing of previous references in the Information Disclosure Statement is also provided including the patents listed in last form PTO-892 by the Examiner.



Rebuttal to Claim Rejections under 35 USC-#103

The claim rejection under 35 USC-#103 is requested to be traversed based on the following remarks (referring to both the new and original specifications):

The processes described within this application are utilizing permreactor designs that are substantially different than the one presented in Itoh's and Oertel's paper. This makes the described processes new and capable to be patented. Specific details on the benefits, novelties of the processes, and differences from previous processes are described in pages 5,6,7 of the section Background of the Invention.

In summary, the installation and operation of the second membrane to withdraw hydrogen out the first annular zone is novel. This is because no other process until now in

patent literature teaches similarly consecutive hydrogen separation and continuous reaction-enhancement operation by a second membrane, for the reactions described, which makes the use of the second membrane not obvious, taking into account the many process and reactor variations which have been described in the literature. The purpose of separating hydrogen out of the second membrane is not merely for separation or purification as pointed out in page 14 of the Office response. Hydrogen separation with installation and use of the second membrane has the purpose of driving continuously the catalytic reactions occurring within the first membrane. Thus, the real purpose of using the second membrane is to lower the partial pressure of the separated hydrogen in the annular space between the two membranes. If hydrogen is not removed continuously by the use of the second membrane, the partial pressure of hydrogen will build up along the membrane length in the annular space, and at some point of the reactor the hydrogen will backpermeate into the first catalytic zone. This effect is detrimental for the operation of the membrane reactor/permreactor and the reactions in the first zone will stop due to the presence of hydrogen product. Withdrawal of hydrogen by the second membrane allows for continuous equilibrium shift and for higher conversions and yields in the first catalytic membrane zone for the occurring reactions, which makes the use of the consecutive second membrane to be novel in the described reaction process operations. The use of the two membrane process makes a new process which operates independently for each reaction occurring, is compact in operation, more economic because it eliminates additional off-gas purification process steps, and specific in purpose to power fuel cells and to feed distinct synthesis reactors. These distinctions are not obvious to the person having ordinary skill in the art to which the said subject matter pertains;

Moreover, the process described in the invention, uses a first membrane which is permeable to other chemical components as well and not only to hydrogen, while the Itoh's and Oertel's processes both are using hydrogen only permeable metal-type membranes. Thus, the use of ceramic or composite materials in first membrane cylinder is a significant process difference by the two previous articles. These materials are projected

to be more economic (less expensive) than the metals (e.g., palladium, palladium-silver) that are almost exclusively used for metal membranes.

Similarly, novelty is presented also in the modified process in which the second membrane separates both hydrogen and carbon dioxide out of the annular zone and the binary mixture is used in special fuel cell and synthesis reaction applications. Continuous separation of both components out of the annular zone allows for the reaction to proceed beneficially in the first catalytic zone and offer increased conversions and yields. Lack of permeation of these two gases from the second membrane will yield to a terminal stopping of the reactions in the first catalytic zone due to the backpermeation of hydrogen and carbon dioxide into this zone. This detail is not obvious to a person having ordinary skill in the art to which said subject matter pertains.

Moreover, the internal specification of the presented process permreactors are distinct in comparison with the ones presented by Itoh and Oertel. This stands for the heating elements and the way of heating the described permreactors and related processes. Also it stands for the developed (gradually reduced) pressure gradient from the inner to the outer membrane and the related zones. Also it stands for the unique way the gas mixture is fed, separated, and directed in consecutive applications in the different sections of the permreactor process, as shown in detail in Figure 2 of the drawings.

Another distinct difference of the described processes is their specific use in interconnected fuel cells and synthesis reactors. The specific delivery of gas mixtures rich in hydrogen and carbon oxides in specific types of fuel cells is distinct. Distinct are also the synthesis reactions which consume the generated hydrogen mixtures from the described processes as was pointed out in the Office Summary. Distinct are also the combination of processes utilizing the permreaction operation and the consecutive separation processes (both membrane permeation and cryogenic separation) which are also related and continue the previous USpatent #6,090,312. These distinctions are not obvious to the person having ordinary skill in the art to which said subject matter

pertains; and these distinctions make the described processes patentable over the previous art.

In summary the described processes with the limitations set are new and differ substantially from previous art. Based on the new (rewritten) claims of the current substitute specification and based on the above remarks/comments, the applicants request from the Office to allow this patent application with the accompanied claims.

The processes described here are of significant interest for developmental purposes in the described technology areas/sectors in both national and international level. The applicants have been invited to present this work at national and international technical conferences. The acceptance of the patent by USPTO is going to protect the rights of this invention which occurred in USA.

Part of the processes described here is intended to be published also in consecutive publications in order to increase the possibility of their commercial use and to show their innovative usages in fuel cells and synthesis reactions.

Memo

TO: USPTO, Assistant Commissioner for Patents.

The application #09/525,176 as amended with this substitute specification in this response on May 28, 2002 contains/includes 45 claims (3 independent claims). The original fee.

The applicants have paid an extra \$54.00 fee on 10/1/2001 for 6 additional dependent claims beyond the original 45 claims filed.